South Fork Nooksack Temperature TMDL

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DEPARTMENT OF
ECOLOGY
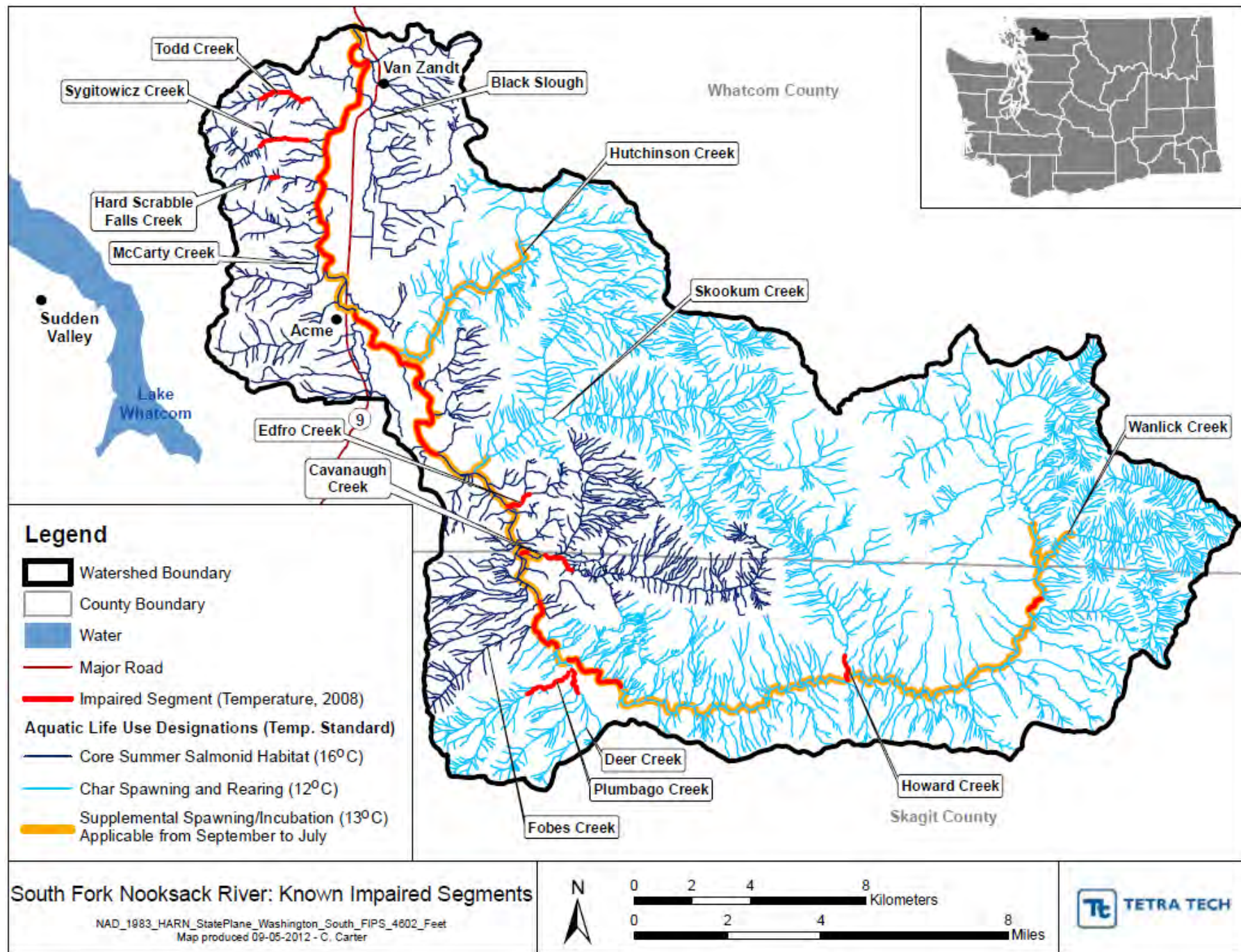State of Washington

OVERVIEW

- Study Area/Watershed Characteristics

- TMDL Overview

- Pollutant Sources

- Temperature Data

- Modeling Temperature

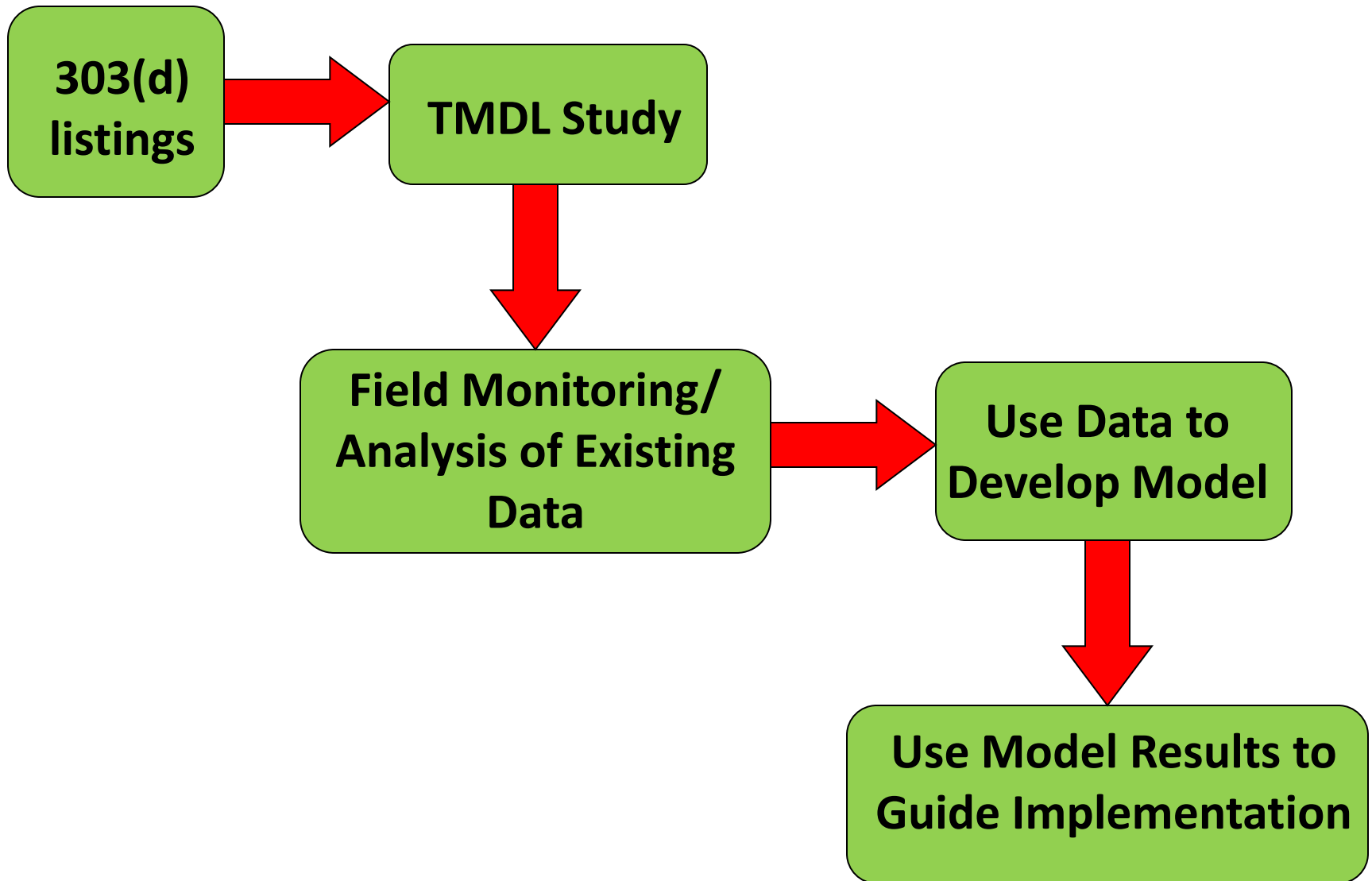- Connection to EPA Climate Change pilot TMDL

Study Area

Watershed characteristics:

- Joins Middle and North Forks just outside study area

- No glaciers

- Ultra Mafic rocks in Sisters

- Land Cover

  - Forestry in uplands

  - Agriculture in lower valley

  - Small amount of rural development

South Fork Nooksack River: Known Impaired Segments

Legend

	Watershed Boundary
	County Boundary
	Water
	Major Road
	Impaired Segment (Temperature, 2008)

Aquatic Life Use Designations (Temp. Standard)

	Core Summer Salmonid Habitat (16°C)
	Char Spawning and Rearing (12°C)
	Supplemental Spawning/Incubation (13°C) Applicable from September to July

Labeled features: Todd Creek, Sygitowicz Creek, Hard Scrabble Falls Creek, McCarty Creek, Van Zandt, Black Slough, Hutchinson Creek, Skookum Creek, Wanlick Creek, Edfro Creek, Cavanaugh Creek, Sudden Valley, Acme, Lake Whatcom, Deer Creek, Plumbago Creek, Fobes Creek, Howard Creek

Whatcom County
Skagit County

NAD_1983_HARN_StatePlane_Washington_South_FIPS_4602_Feet
Map produced 09-05-2012 - C. Carter

0 2 4 8 Kilometers
0 2 4 8 Miles

TETRA TECH

S. Hood/T.Mohamedali: SF TMDL   WRIA 1 Climate Change Workshop   January 22-23, 2013

TMDL Study Process

303(d) listings → TMDL Study → Field Monitoring/Analysis of Existing Data → Use Data to Develop Model → Use Model Results to Guide Implementation

What is a TMDL?

- Total Maximum Daily Load
  - How much stuff can we dump in the water each day and still meet water quality standards
  - Who has to cut back on their dumping of stuff to achieve the target

What is a TMDL?

- Initiated when a state waterbody violates water quality standards…

- Each State shall establish … the total maximum daily load… Such load shall be established
  - at a level necessary to implement the applicable water quality standards
  - with seasonal variations and
  - a margin of safety which takes into account any lack of knowledge ….

Isn't there more to it than that?

- 40CFR130.1(i) & 40CFR130.7(c)(1)

$$TMDL = \sum WLA + \sum LA + MOS$$

- – Wasteload Allocation → Permit Limits
- – Load Allocation →Nonpoint sources may include background
- – Margin Of Safety → address uncertainty that WQS will be met

What is our target?

- Water Quality Criteria are based on the most restrictive use.
    - Char Spawning and Rearing (12 ˚C)
        - Upper valley tributaries
    - Core Summer Salmonid Habitat (16 ˚C)
        - Lower valley tributaries
    - Supplemental Spawning and Incubation (13 ˚C)
        - From September-July

What if the Criteria Cannot be Met Under Natural Conditions?

- If natural conditions exceed the criteria human increase is limited to 0.3 ˚C.

- 17th Century land cover combined with current climate and hydromodifications

- In a changing climate –
  - 17th Century land cover and future climate.

- We will see a shift in locations where criteria can be met.

Potential Pollutant Sources

- Loss of vegetation within riparian zone

- Human activities that change stream channel morphology

- Reduction in flows: baseflow, instream, groundwater, hyporheic exchange

- Urban stormwater

- Forest practices

(There are no direct point sources in SF Nooksack R)

Load Allocation for Temperature TMDLs

- Shade used as a surrogate
  - Heat is the pollutant, shade prevents the discharge
- Riparian vegetation increases shade, reduces heat load
- Load allocations are in terms of % effective shade blocked by topography and riparian vegetation
- Other factors (groundwater, channel morphology, etc) usually addressed in a narrative form, not as a specific load allocation
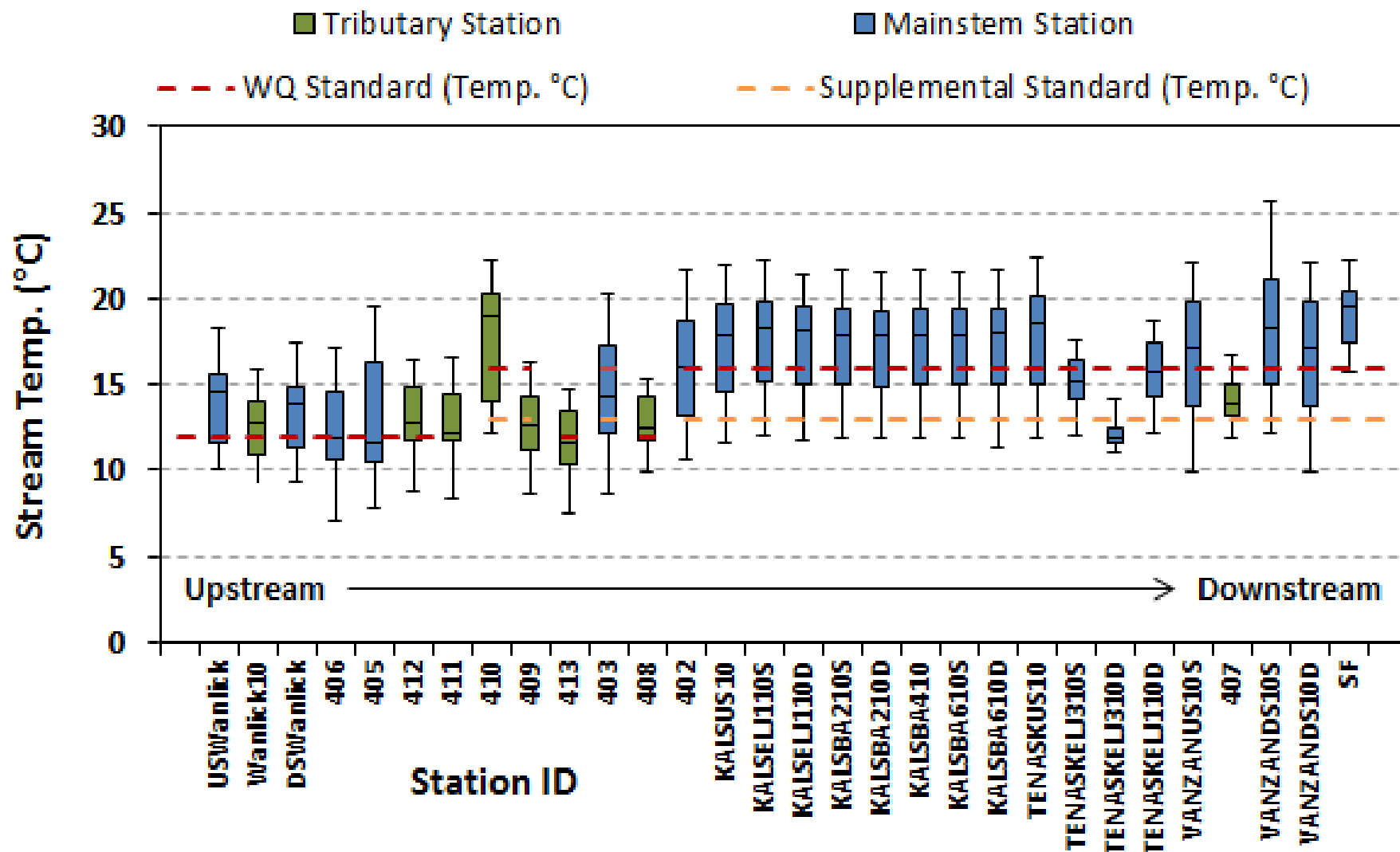
Temperature Data

- Most data have been collected by the Nooksack Indian Tribe
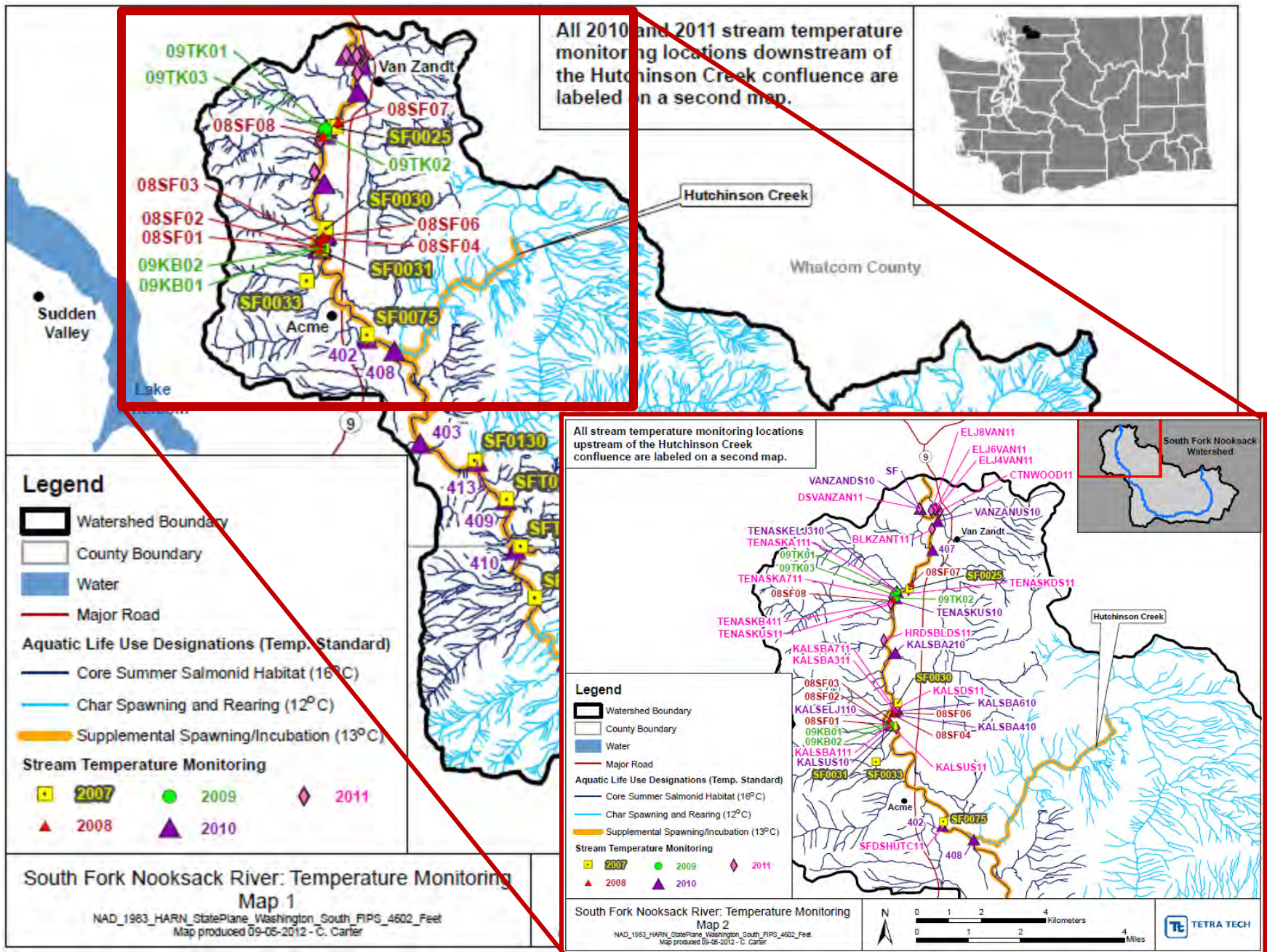
Temperature Data

- Most data have been collected by the Nooksack Indian Tribe

- Will focus on 2010 data:
  - 22 locations on mainstem
  - 8 locations on tributaries

- Data summarized as a 7-DADMax: highest seven-day average of daily maximum temperatures (consistent with WQ standard)
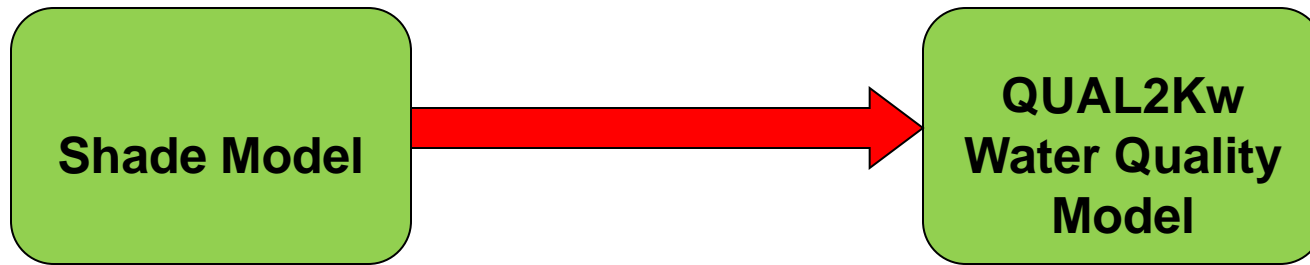
Temperature Data: 2010

Modeling Temperature

Why Model?

- Allows us to simulate existing conditions

- Once calibrated, can be used to evaluate different scenarios e.g.:

  - Natural conditions w/ full riparian vegetation

  - Current conditions w/ full riparian vegetation

  - Climate change scenarios with different flows and temperature boundary conditions

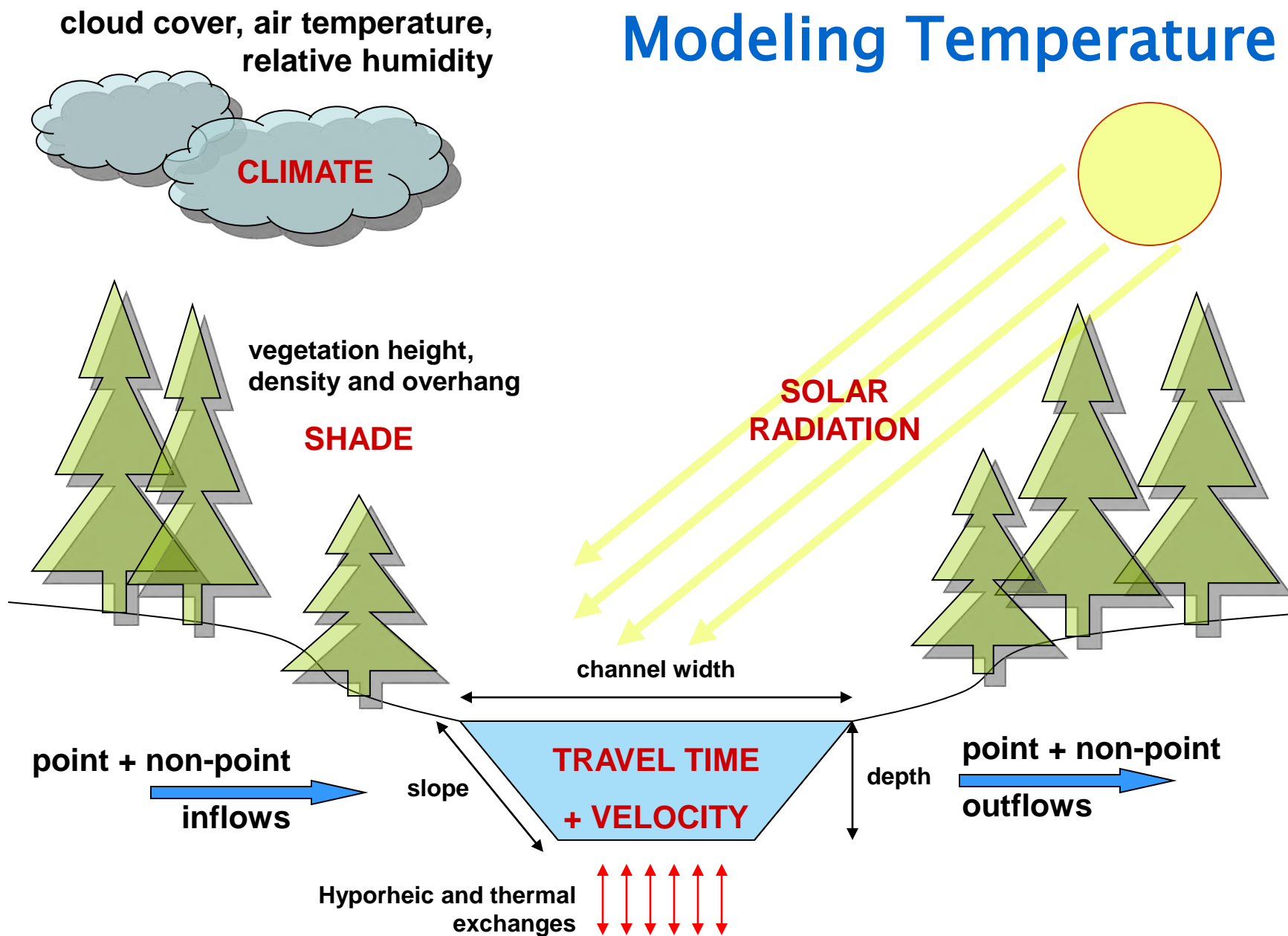 - Explore different options for reducing temperature

Modeling Temperature

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┌─────────────────┐                    ┌─────────────────┐
│                 │                    │    QUAL2Kw      │
│   Shade Model   │ ─────────────────▶ │  Water Quality  │
│                 │                    │     Model       │
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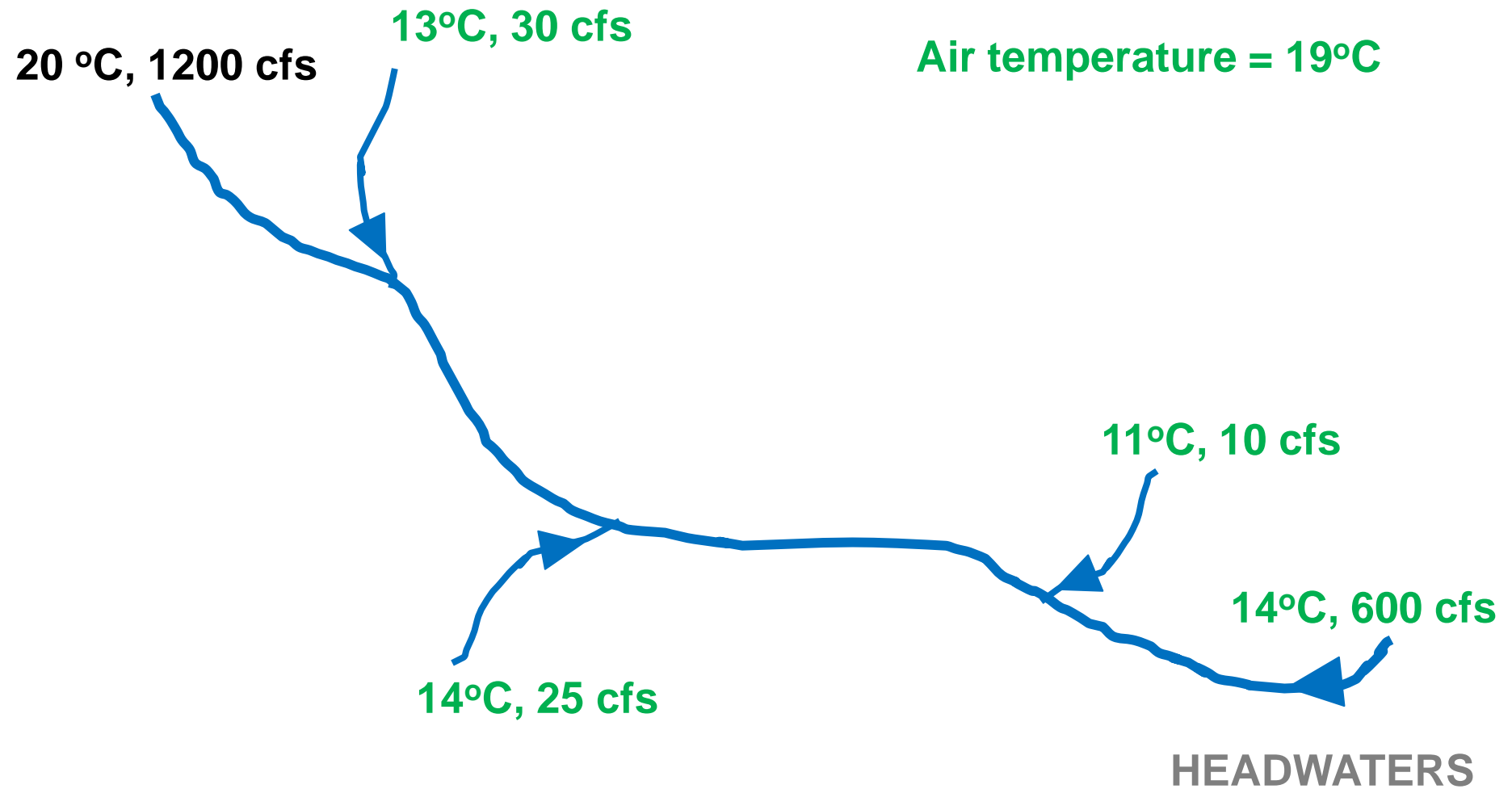
- Channel geometry
- Topography, elevation
- Aspect
- Riparian characteristics
- Solar radiation

- Headwater temperatures
- Tributary temperatures
- Flow and hydraulics
- Meteorology
- Channel geometry

cloud cover, air temperature, relative humidity

CLIMATE

Modeling Temperature

vegetation height, density and overhang

SHADE

SOLAR RADIATION

channel width

point + non-point

inflows

slope

TRAVEL TIME + VELOCITY

depth

point + non-point

outflows

Hyporheic and thermal exchanges

Modeling Temperature

20 °C, 1200 cfs

13°C, 30 cfs

Air temperature = 19°C

11°C, 10 cfs

14°C, 600 cfs

14°C, 25 cfs

HEADWATERS
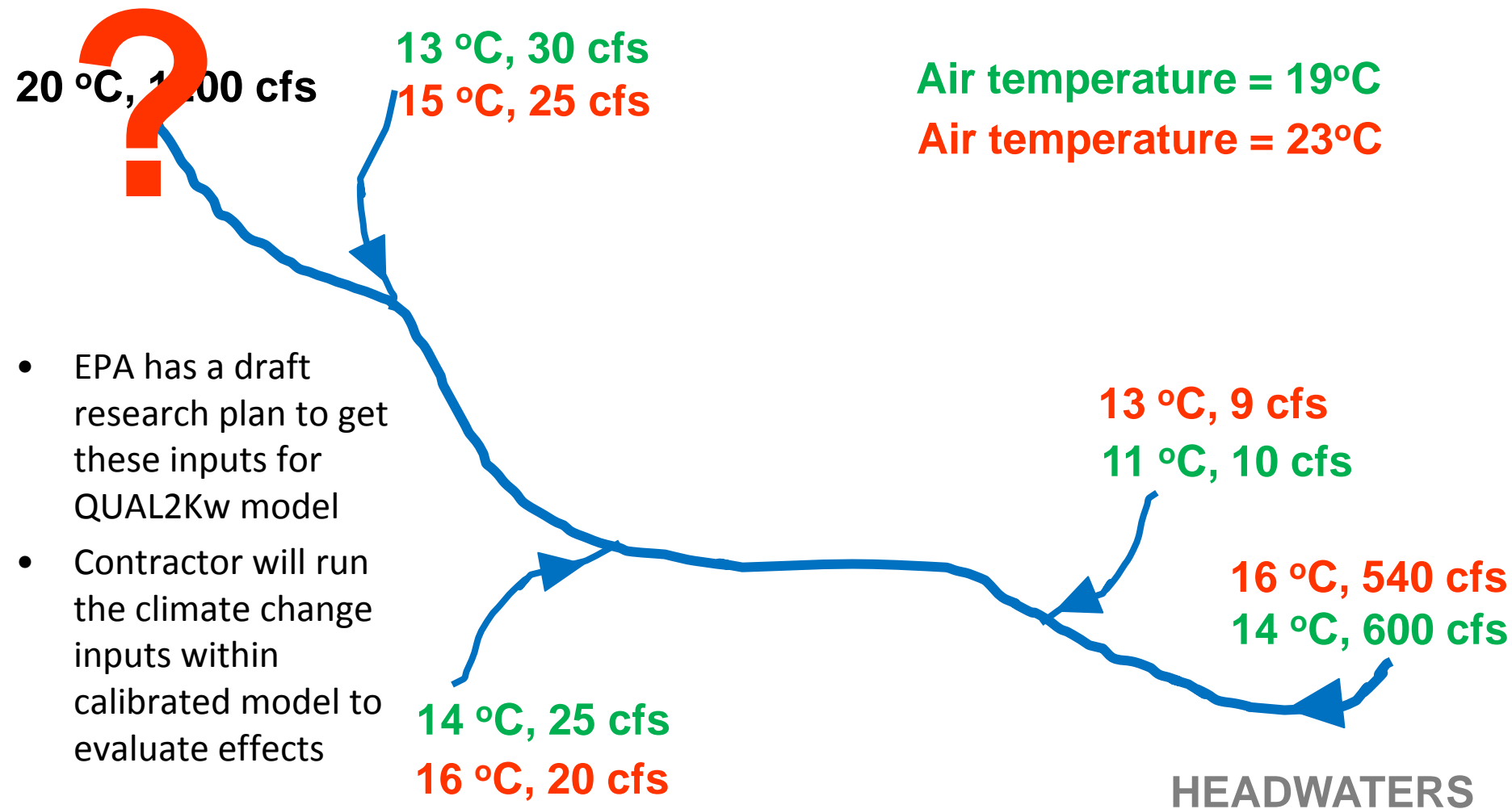
EPA Climate Change Pilot TMDL

- Regulatory TMDL vs. climate change pilot project

- EPA will provide contractor with modified climate change inputs for QUAL2Kw:
  - Headwater temperature
  - Tributary temperatures
  - Air temperature
  - Flow

Modeling Climate Change

20 °C, 1000 cfs

13 °C, 30 cfs
15 °C, 25 cfs

Air temperature = 19°C
Air temperature = 23°C

- EPA has a draft research plan to get these inputs for QUAL2Kw model
- Contractor will run the climate change inputs within calibrated model to evaluate effects

13 °C, 9 cfs
11 °C, 10 cfs

16 °C, 540 cfs
14 °C, 600 cfs

14 °C, 25 cfs
16 °C, 20 cfs

HEADWATERS

Questions?

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